NEXRAD Product Improvement
Open Radar Data Acquisition (ORDA)
Test and Evaluation Master Plan (TEMP)

NWS Office of Science and Technology

29 August 2002

TABLE OF CONTENTS

PART I-INTRODUCTION

This section describes the scope, mission description, and system description of the Weather Surveillance Radar -1988 Doppler (WSR-88D) System Open Radar Data Acquisition (ORDA) test and evaluation program. This Test and Evaluation Master Plan establishes the events necessary for the ORDA program to meet the requirements outlined in IEEE 1012-1998, Annex B, for Software Integrity Level 2.

1.1 Scope

The national network of Weather Surveillance Radar 1988 - Doppler (WSR-88D) systems provides critical data to the nation's civilian and defense weather service's to protect the public, aviation, and military assets through warnings and forecasts of severe weather. Modifications to the hardware and software of this complex system must undergo rigorous, formal testing to ensure the system remains stable, reliable, and useable. Several Government and Corporate organizations are involved in this test and evaluation effort for the ORDA. They are the NOAA National Weather Service (NWS) Office of Science and Technology (OS&T), the Radar Operations Center (ROC), the Air Force Weather Agency (AFWA), which is a branch of the Department of Defense, the Federal Aviation Administration (FAA), which is a branch of the Department of Transportation, the ORDA Contractor (RS Information Systems, Inc.) of McLean, Virginia, and Mitretek Systems, Inc. of Falls Church, Virginia.

The ORDA subsystem Test and Evaluation Master Plan (TEMP) describes how the Government intends to ensure the availability and stability of the WSR-88D system through a formal test program of the ORDA functional area. This plan identifies the OS&T, ROC, and contractor organizations, defines their roles, presents the general approach of the test program, defines the types of tests, types of equipment needed, the test planning and scheduling process, and the needed test documentation. It also addresses the verification of requirements with the use of the Dynamic Object Oriented Requirements System (DOORS) to ensure requirements traceability. It also addresses the test preparation, execution, and reporting process, and the certification of external system interfaces. In summary, this TEMP address all phases of the test program from requirements verification to the customer's on-site acceptance of the ORDA.

This TEMP is tailored from the format defined in Chapter 16 (Test and Evaluation Management Plan) of the Defense System Management College (DSMC) Test and Evaluation Management Guide (TEMG, dated: March 1998). This guide defines DOD Standard 5000.2-R, Mandatory Procedures for Major Defense Acquisition Programs (MDAPS) and Major Automated Information System (MAIS) Acquisition Programs; 10 June 2001, as the necessary guides to use as the model for a TEMP. The DSMC TEMG states that a TEMP needs to be a short, dynamic, and working document. Several other commercial and military standards are value added in their contributions as guides to design in the TEMP for specific content and format.

1.2 System Description of ORDA

The WSR-88D Radar consists of three functional areas; the Radar Data Acquisition (RDA), the Radar Product Generator (RPG), and the Principal User Processor (PUP). The NEXRAD Product Improvement (NPI) project aims to evolve each functional area using modern commercial-off-the-shelf (COTS) equipment and open system industry standards. The RDA functional area consists of a coherent, pulsed Doppler radar and its associated hardware and software operating in the 2.7 to 3.0 GHz frequency band. The RDA operates continuously, covering a volume of space under control of the preprogrammed scan scenarios to provide estimates of meteorological data. The RDA is designed for fully automated operation under executive control of the RPG functional area. These operations include transmit, receive and signal processing functions, system calibration, system performance monitoring and the transmission of radar and status data to the RPG. The RPG functional area supports the generation, local storage, distribution, and archiving of WSR-88D weather products, and the control of the associated RDA. The RPG uses base data received from the RDA, and hydrometeorological data received from the Rain Gage Data Acquisition Computers (RGDACs) to generate a set of meteorological products and distributes them to product users through dedicated and dial-up communication lines. WSR-88D users include Weather Forecast Offices (WFO), River Forecast Centers (RFC), National Centers for Environmental Prediction (NCEP), Air Route Traffic Control Center (ARTCC), Terminal Radar Approach Control Facility (TRACON), Air Force, Navy, and other commercial users through service providers.

The RDA consists of a transmitter, a receiver, an antenna, and associated control and monitoring equipment. Many of these components are unique to the WSR-88D and are custom built for this radar. Any future enhancements such as polarimetric capability require significant modification of the RDA modules. By far the most essential and difficult task required before the WSR-88D program makes any other changes is the replacement of the existing signal processor and control/status computer. These components are proprietary and have reached technological obsolescence. The goal of the first phase of the RDA enhancement consists of replacement of the signal processing subsystem (SPS)and the RDA status and control computer (RDASC) with a modern flexible and scalable system. This equipment consists of over 40 electronic modules and comprises the primary computing and control platform for the RDA since all RDA operations are initiated and controlled by this functional area.

PART II-ORDA TEST AND EVALUATION ORGANIZATION AND RESPONSIBILITIES

This section describes the organization and their responsibilities with the test and evaluation efforts for the ORDA. Section 4.2 (Organization) of the NEXRAD Product Improvement (NPI) Project Plan provides more information on the roles of the participants and stakeholders, as well as an organization chart.

2.1 NWS Office of Science and Technology (OS&T)

The NPI Program Manager (PM) has overall responsibility for planning and executing the test program following OS&T Systems Engineering Center (SEC) guidance and approval. The NPI PM will coordinate with the ORDA Project Engineer (PE), the ROC, the Contractor, and the Verification and Validation (V&V) Group on all test and evaluation activities and issues. This includes monitoring the progress of test planning, test management, test document production, test resources, test conduct, and test results reporting.

2.2 ORDA Contractor

The Contractor will lead the component and integration phases of the ORDA project. Specifically, the Contractor will lead a team of contractor personnel who will complete the development and test of all elements of the ORDA during the component test phase and the integration test phase. For these two development phases, the contractor will develop all formal test plans, test descriptions, and test reports. This means that the contractor will design, document, execute, and report results for software unit testing, hardware component testing, and integration testing of the modified subsystems in the context of the WSR-88D system. The contractor will also perform a support role in the activities associated with WSR-88D system testing and WSR-88D on-site acceptance tests. The ROC will lead the conduct of the system and acceptance tests. During system and acceptance tests, the contractor will provide draft test procedures, technical assistance, and support to the ROC. The ROC staff will conduct the System test and Pre-Beta Acceptance Test using the KCRI testbed in Norman, Oklahoma. They will also conduct a second part of the acceptance test on a WSR-88D system called the Field Site Beta Test. The contractor will conduct initial confidence testing on each deployed system to verify the system's operational integrity as part of the Installation and Check-out (INCO) deployment activities. Following the INCO, the contractor, OST and the ROC will turn the system over to the field site personnel for robust operational testing.

The ORDA Contractor Technical Planning and Management (TP&M) Focal Point ensures that all contractor lead tasks in the test and evaluation program will be adequately planned, managed, and performed. Other contractor personnel, for example the Test Team Leader, will assume major roles in completing the ORDA test planning, management, and execution, and reporting consistent with the contents of this TEMP.

2.3 WSR-88D Radar Operations Center (ROC)

The ROC will provide and manage facilities and testbed assets to support the system and pre-beta acceptance tests. The ROC will provide testbed time to the contractor during the later stages of the Integration Test phase for development and dry-runs of the draft System Test procedures. Additionally, the ROC will provide WSR-88D subject matter expert (SME) personnel to support testing activities as described below.

2.4 Independent Verification and Validation (V&V) Group

The ORDA IV&V Group consists of Government and contractor personnel. This team is independent from, but works closely with, the ORDA Contractor software and hardware design and development, QA, CM, and test teams. The organizations comprising the IV&V Group consist of representatives from the NWS OS&T, the NWS, and the ROC and optionally members from the FAA and DOD. The IV&V Group will review the ORDA Contractor's test documentation, including plans, descriptions, and reports. The ORDA IV&V Group will also monitor the execution of all formal tests and dry-runs if deemed necessary. An IV&V Group representative also receives test activities status and results information from the Contractor and reports this directly to the PM.

2.5 Test Review Board (TRB)

The Test Review Board (TRB) consists of designated personnel from the Government and contractor. Their primary purpose of the TRB is to classify and prioritize test anomalies. During the component and integration test phases, the contractor will maintain an internal TRB. Beginning with the System Test phase, the Government will lead the TRB and the contractor will participate as part of System Test and Acceptance Test support Activities. The TRB may recommend tentative courses of action to efficiently and effectively resolve anomalies or provide concurrence to anomaly resolution approaches. These recommendations are subject to program management review.

PART III-ORDA TEST AND EVALUATION ACTIVITIES

This section will describe in detail the ORDA test and evaluation activities. The test activities will follow the guidelines of IEEE Standard for Software Verification and Validation (IV&V), IEEE-1012-1998.

3.1 Test and Evaluation Details

All ORDA test and evaluation activities are requirements-based. The TRB is responsible for all test anomaly classifications and prioritization activities. The TRB will classify each test anomaly into one of three test anomaly categories. Test Anomaly categories are:

- Withdraw issue – Requirement(s) met.
- Passed with waiver/deviation (waiver/deviation request submitted).
- Failed - Retest Required following corrective actions by development engineers.

Completing each test phase and advancing to the next test phase requires that the TRB has classified all defects into one of three final defect disposition states. These three final defect disposition states (resolutions) are:

- No Action - Passed with waiver/deviation – Waiver/Deviation request submitted and tentatively approved.
- Deferred - Deviation request submitted and tentatively approved.
- Closed – Retest passed and requirement(s) met or assessed to another system.

Additionally, the TRB is responsible for the prioritization of defects. The TRB will prioritize each issue into one of three defect priorities which are:

- Critical
- Major
- Minor

3.1.1 Types of Tests

The following subsections define the types of tests used in the ORDA test and evaluation effort. The test types and objectives address the functional, performance, and stability requirements of the WSR-88D system. The following subsections describe the types and objectives of the tests.

3.1.1.1 Component Tests

The primary objective of component testing is to verify the implementation, design and selection of software item(s), hardware item(s), and firmware item(s) to satisfy allocated requirements to individual components. The West Oaks contractor facility, test environment in Norman, Oklahoma, will host the ORDA component tests. Upon

completion of the component tests, there should exist a high degree of confidence that integrating of the set of discrete components will result in a subsystem that meets all allocated functional and performance requirements for the subsystem. The contractor will record, analyze, and recommend classifications for all test anomalies discovered during component testing. Additional details are contained in the component test plan. The Component test plan will be delivered as specified in the CDRL.

3.1.1.2 Integration Tests

Integration testing is an orderly progression of internal interface testing that results in a completed subsystem. The combination of all ORDA software items, hardware items, and firmware items constitute the upgraded subsystem. The ORPG external interface is the only external interface in the ORDA functional area tested during integration testing. This interface is critical in terms of risk to the ORDA upgrade. The contractor will mitigate this risk by testing this interface before System Test. Additionally, the RMS external interface will be tested via simulation in accordance with the ICD or with system test bed time allocated before System Test begins.

The West Oaks contractor facility, test environment in Norman, Oklahoma, will host the ORDA internal integration tests and one external interface test with the ORPG and an ORPG software build produced by the ROC in accordance with the ORPG/ORDA ICD. To test the one external interface, an ORPG with modified and configuration managed software is required at the West Oaks contractor facility. Upon completion of integration tests, there should exist a high degree of confidence that integration of the upgraded subsystem into the WSR-88D system will satisfy allocated functional, performance, and stability requirements. The contractor will record, analyze, and recommend classification of all test anomalies discovered during integration testing.
Additional details are contained in the Integration Test Plan. The contractor will deliver the Integration Test Plan as specified in the CDRL

3.1.1.3 System Tests

System testing is the process of formally testing allocated functional, performance, and stability requirements in a fully integrated hardware, software, and firmware WSR-88D system. System Testing will also include all activities required for the Security Certification and Accreditation. Performing the Security Certification and Accreditation at this point requires a completed Security Plan and draft Security test procedures. System tests require the use of the KCRI system test environment managed and maintained by the ROC. All software, firmware, and hardware tested during system testing will be Configuration Managed by the ROC using the RAZOR CM tool. The objective of the system tests is to verify that all functional, performance, and stability requirements allocated to the WSR-88D are fully satisfied or brought to a final defect disposition state. Additional System Test requirements will include test bed time to develop draft Technical Manuals. See the System Test Plan for additional details. The Contractor will deliver a draft System test plan as specified in the CDRL

3.1.1.4 Acceptance Tests

Acceptance testing is the process of formally conducting a set of functional, performance, stability, and maintenance demonstrations and Technical Manual verification activities on the WSR-88D system to verify that the system satisfies its agreed-upon acceptance criteria. The ROC will conduct the Pre-Beta Acceptance Test at the ROC test bed. The first part of the Acceptance Test precedes the actual Acceptance Test by the customer at an actual field site. The Acceptance Test includes testing the software loads, kit contents, user manuals and performance of a maintenance demonstration. This first part of acceptance testing, formally referred to as the Operations test, is done using the KCRI testbed at the ROC. These tests, designed from the user's perspective, are done in an operational test environment which closely reflects a customer site. The objective of the pre-beta tests are to verify that all functional, performance, stability, and maintenance requirements allocated to the WSR-88D are fully satisfied or brought to a final defect disposition state.

In the Field-Site Beta Acceptance Test, chosen sites will represent the entire WSR-88D user community. The Field-Site Beta Acceptance Test will verify the installation procedures, WSR-88D functional performance, long-term stability, training issues, and the technical support documentation to maintain the WSR-88D system. Upon conclusion of the Acceptance Tests, a recommendation will be requested whether or not to accept the system during system deployment. Additional details are contained in the Acceptance Test Plan. The draft Acceptance Test Plan will be delivered as specified in the CDRL.

3.1.2 Methods of Verification

The ORDA program will use four industry standard and accepted methods of verification in the test and evaluation effort. The four methods are inspection, analysis, demonstration, and test.

(a) Inspection. This method verifies properties determined by examination and observation.

(b) Analysis. The processing of accumulated data obtained from other qualification methods. Examples are reduction, interpolation, or extrapolation of test results.

(c) Demonstration. The operation of the system, or part of the system, that relies on observable functional operation not requiring the use of instrumentation, special test equipment, or subsequent analysis. In this method the developer selects the stimuli.

(d) Test. The operation of the system, or part of the system, that uses instrumentation or other special test equipment to collect data for later analysis. This test is similar to demonstration except that the system stimuli is selected by the customer.

3.2 ORDA Test Phases

The OS&T ORDA Program and Technical Management briefing held on 11-12 July 2001 identified four IEEE 1012-1998 requisite test phases. The ORDA program will require all four sequential test phases to accomplish the methodical test objectives contained in Section 3.1.1 of this document. A Test Readiness Review (TRR) milestone separates each test phase. At the interim TRRs, the TRB will address the question as to whether or not the objectives for the current test phase were met and introduce the objectives for the next test phase. Failure to meet exit criteria for the current test phase or entry criteria for the next test phase at the interim TRRs will require actions as specified in the Risk Mitigation Plan.   The TRB will have a final disposition for every defect with no open critical defects at each interim TRR. The following subsections identify the test phase objectives, entry criteria, and exit criteria for each test phase.

3.2.1 Component Test Phase

The purpose of component test phase is to verify that allocated requirements are met by the software (e.g. modules), firmware (e.g. non-volatile PROM), and hardware items (e.g. receiver) selected and/or developed for the ORDA functional area of the WSR-88D system.

Entry criteria consist of adequately specified requirements synthesized into software, firmware, and/or hardware items.

Exit criteria for component test phase are the successful completion of objectives outlined in the Component Test Plan. Once the component tests meet allocated requirements, with any open defects in one of three final disposition states, the component test phase is complete. The contractor will deliver a final test report per the CDRL.

3.2.2 Integration Test Phase

The purpose of integration test phase is to verify the internal interfaces between the various discrete components qualified in the component test phase. These tests verify that the integrated components collectively satisfy requirements allocated to the upgraded subsystem consisting of the receiver, synchronizer, and signal-processor. This subsystem provides the framework for future open-systems expandability and performance improvements to the WSR-88D system (e.g. SIGMET enhancements, "new science").

Entry criteria for integration test phase are successful completion of the component test phase.

Exit criteria for the integration test phase are successful completion of objectives outlined in the Integration Test Plan. Once the subsystem meets all allocated requirements and any open defects are in one of three final disposition states, the integration test phase is complete and a final test report will be delivered per the CDRL.

3.2.3 System Test Phase

The objectives of the System Test phase are to verify the function, performance, and stability requirements allocated to the ORDA functional area. The tests, designed and dry-run by the contractor during the later stages of the Integration Test phase, are done on the ROC's testbed with both contractor and ROC personnel.   The ROC's ORPG(s) will need to be upgraded with new software which meets the ORPG/ORDA ICD. In addition to verifying integration within the WSR-88D system, additional goals for completion of system test phase include verification of the ROC testbed upgrade, verifying the Technical Manuals and doing the Security Certification and Accreditation as defined in the Security Certification and Accreditation Plan.

Entry criteria for system test include the successful completion of Integration Test phase and successful retrofit of the ROC's KCRI test bed with the upgraded ORDA. The ROC, with the assistance and consultation with the contractor will verify all functional, performance, and stability requirements allocated to the RDA functional area within the WSR-88D system.

Exit criteria for the system test phase are successful completion of objectives outlined in the System Test Plan. The System Test Plan includes activities required to complete the system test phase including the ROC testbed verification and completion of the NEXRAD Security Accreditation. Once the RDA functional area meets all allocated requirements and any open defects are in one of three final disposition states, the System Test phase is complete and the contractor will deliver a draft System Test Report per the CDRL.

3.2.4 Acceptance Test Phase

The NWS requires the ORDA program to conduct an Acceptance Test before full WSR-88D deployment. Personnel independent of the developer and a representative of the user community will conduct these tests. See the subsections below for the Acceptance Test phase objectives.

Entry criteria of the acceptance test phase are successful completion of the System Test phase. The Acceptance Test Plan will identify additional entry and exit criteria for the Acceptance Test Phase.

Exit criteria are successful completion of the objectives outlined in the Acceptance Test Plan. Once the Acceptance Test phase is complete, the contractor will deliver a draft Acceptance Test report per the CDRL.

3.2.4.1 Pre-Beta Acceptance Tests

The ROC will conduct Pre-Beta Acceptance Test, formally referred to by the ROC as the Operations Test, on ROC testbed assets. These tests should be conducted on testbed KCRI since it provides an environment that closely resembles a dual channel customer site. The objectives of this test are to verify the system upgrade, software loads, kit

contents, technical manuals and a maintenance demonstration in preparation for the actual Field-Site Beta Test Phase.

3.2.4.2 Field-Site Beta Tests

The ROC will conduct Field-Site Beta Tests, formally referred to by the ROC as the Beta Test at selected field sites. These tests represent the first opportunity that the customer has to load the upgraded software, install the upgrade kit, verify the functional performance, stability of the upgrade, verify the technical manuals and assess training effectiveness. In addition to the actual tests, the ROC will solicit feedback from customers regarding the system upgrade effectiveness in terms of progress against stated objectives in the Acceptance Te st Plan. Actual use of a WSR-88D in an operational environment verifies the functional, performance and stability requirements. The ROC coordinates selection of the Field Beta Test Sites. A representative cross-section of customer sites participates in this test. For example, at least one NWS, NWS-Redundant, DOD, and FAA site will act as the user representative site for the Field-Site Beta Test.

3.2.5 Deployment Installation and Checkout (INCO) Tests

Once ORDA deployment to Beta sites begins, the contractor will conduct INCO tests at all installation sites. The primary objective of the INCO test is to demonstrate basic functionality, interconnectivity, operation of components and overnight stability of the WSR-88D system following the installation of the upgraded ORDA functional area subsystem. WSR-88D customers witness these basic confidence tests. The INCO test should detect faulty or damaged components or components that may have been incorrectly configured during the installation process.

3.3 Test Requirements Matrix Generation

DOORS can easily generate a Requirements Traceability Matrix (RTM) in real-time. In all ORDA B-level requirements specifications and Software Requirements Specifications, the ORDA program office will conduct an RTM review. Generating the RTM can be easily accomplished by selecting the RTM view. This provides an RTM that is based on real-time data across the entire development spectrum from requirements through test results, depending on the stage of development or verification.

3.4 ORDA Test Schedule

Figure 1 displays a chart showing the time sequencing of the major development milestone schedule, complete with test and evaluation phases and events for the ORDA.
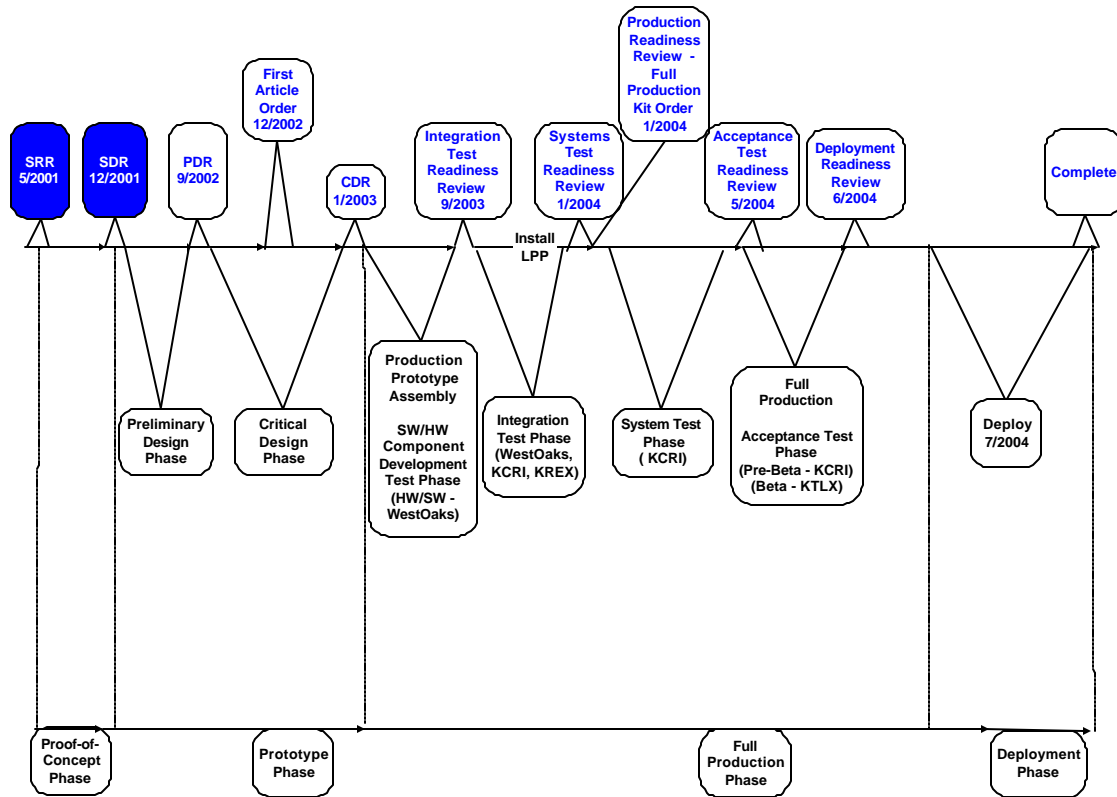
Figure 1. ORDA Schedule

3.5 Quality Assurance (QA) Provisions

The contractor will be responsible for all quality assurance during the ORDA test program. The contractor will develop and deliver a Quality Assurance Plan per the CDRL.

3.6 Configuration Management (CM) Provisions

The contractor will be responsible for all configuration management during the ORDA test program. The contractor will be responsible during the component and integration test phases and the ROC will be responsible starting with the system test phase. The contractor will develop and deliver a Configuration Management Plan per the CDRL.

PART IV-ORDA TEST PLANNING AND EXECUTION

This section describes all the appropriate actions needed to properly plan and execute the ORDA test program. The contractor will lead Component and Integration test phases.

The ROC will lead System and Acceptance Test phases. The following subparagraphs will refer to the contractor or the ROC as the test team with this understanding in mind.

4.1 Test Plan Development

The test team will develop a test plan for each formal phase of testing. There will be four formal test phase plans (Component, Integration, System, and Acceptance) to identify the test entry criteria for the phase, the scope of the tests and the objectives to satisfy completion criteria. Development of comprehensive test plan details before each phase of formal testing will help ensure that WSR-88D system changes are timely, accurate, methodical, thorough and efficient. Adding detail to the test plans in parallel with development reduces the risk of intensive rework before and during test execution. Preparation of the test plans forces the test team to fully contemplate the entire test process and resource requirements. By creating test plans for each test phase, the test team can anticipate and plan the resource requirements, develop contingencies and proactively address potential problems. Since an interim milestone will separate each test phase , the TRB will review criteria for advancement into subsequent test phases and provide appropriate recommendations.

4.2 Test Description Development

The test team will develop test descriptions for each phase of testing. These test descriptions will clearly describe the overall test phase objectives, provide incoming DOORS links from the Test Plans, and contain outbound DOORS links to the test cases that have more specific test cases. The test team will draft Test Descriptions during the system design phase and deliver them per the CDRL. The Test Descriptions are redlined and completed during the specific phase of testing. Final Test Descriptions completed at the end of each test phase.

4.2.1 Test Case Development

The test team will develop one or more test cases for each test contained in the Test Description. The Test Case will clearly state the purpose of the test case, provide incoming DOORS links from the Test Descriptions and specific functional requirements if applicable, and provide outbound DOORS links to the test procedures that contain the very specific steps to be followed during test procedure execution. The test team will deliver draft Test Cases during the system design phase. The draft test cases will be delivered per the CDRL. The Test Cases will be redlined and completed during each phase of testing with final Test Cases completed at the end of each test phase.

4.2.2 Test Procedure Development

The test team will develop one or more test procedures for each test case in the Test Description. The test procedures provide incoming DOORS links from the Test Cases and specific functional requirements, if applicable, contain step-by-step actions necessary to satisfy the objectives of a particular test case and make available outbound links to the

Test Reports. The draft Test Procedures are developed during the system design phase and will be delivered per the CDRL. The Test Procedures will be redlined and completed final during each phase of testing with final Test Procedures completed at the end of each test phase.

4.3 Test Report Development

The test team will develop a Test Report for component and integration phases of ORDA testing. The test team will submit draft Test Reports for the System Test and Acceptance phases. The ROC will update the draft report and submit a final Test Report for the System and Acceptance phases of ORDA testing. The Test Reports will contain incoming DOORS links from the test procedures. The final Test Reports will be delivered per the CDRL.

4.4 Tools, Techniques, and Methodologies

The contractor will select those tools that aid them the best in the test and evaluation process. These include everything from low-level tools that are closest to the instrumented code and the farthest from the final system. This includes those supplied by the computer or development language vendors. Selection of the software unit test tools is described in the System Development Plan. They are usable in a variety of applications, but they are not much good for testing a complete system. Examples of these kinds of tools are syntax analyzers, complexity analyzers, and debuggers. The contractor will analyze, evaluate and recommend test tools suited to support the Integration Test Phase. Examples of these kinds of tools are black-box testing tools and simulators. These types of tools work with the entire system, taking a black-box approach to testing and validation. These tools provide input situations to the product and, in many cases, intercept and analyze the response. Such tools are called "simulators" because they attempt to simulate the entire environment in which the software must operate. The contractor will research COTS test tools for applicability to the ORDA project. Emphasis will be on test tool integration, interface simulation, and automated testing capabilities.

4.5 Test Conduct Preparations

This section describes the conduct of the contractor, the ROC, and the IV&V Group for executing and witnessing all formal tests. After the test planning process is complete, but before testing begins, certain test preparation activities should take place to preclude false starts or invalidating tests. Preparing to test involves coordinating the following test activities with appropriate test personnel, and in some cases, off-site acceptance test personnel.

(a) The test team will hold a preliminary meeting to coordinate test activities with appropriate test staff. All test preparation activities need to be coordinated with all groups involved in the tests. This includes ensuring that all facilities are available and properly scheduled for conduct of the test, that all support staff are available and

scheduled to support the checkout of the test bed and test item for the conduct of the test, that contractor SQA and SCM can support the test.

(b) The support staff then checks out and prepares the test bed to confirm its correct configuration.

(c) The support staff then needs to install the test item and verify the test item is complete and operating correctly.

(d) The support staff needs to gather all test tools, simulators, and test input data as specified in the test plan. The test leader needs to ensure that the test tools are compatible with the software and test bed configuration to be tested. All software test tools need to be under QA and CM control and have appropriate user documentation.

(e) The contractor, ROC, and V&V Group will hold a formal TRR meeting, by teleconference if necessary, to confirm readiness to start each test phase.

4.6 Test Execution

This section describes the methodology for executing all formal tests. During the execution of tests, the contractor test team will:

(a) The Test Team Leader and Test Director hold a preliminary "kickoff" meeting with the test teams, including the V&V Group, on the first day of the test. At this meeting, they should review test procedures for any changes or deviations ("red-lines"), including any special test setup modifications, along with a review of the test execution process discussed in this section. Test Team Members should clearly understand what, where, and when they are to conduct test activities.

(b) Maintain a test log throughout the test. Tests must be exactly repeatable to recreate and analyze anomalies that occur during the tests. Therefore, the test team should carefully document each step taken during the setup and execution of a test. A test log provides a chronological record of the detailed execution of a test.

(c) Control the test bed configuration. The test teams will follow the Test Director's Office procedure OSFCOP-DIR-36 Test Bed Configuration Control during testing. The Test Director should set and control the test bed configuration during testing, and document changes to the test bed in the appropriate test bed logs.

(d) Document, investigate, and track all deviations from the test plan or test procedures. Anomalies are unexpected conditions, events, or faults that occur during a test. All anomalies will be documented, even if they can be explained at the moment. The Test Director will thoroughly investigate all anomalies.

(e) Process all recorded anomalies. The contractor test team will document and submit all anomalies to the contractor Test Director with all appropriate system-level files and

data. They will use the RAZOR as a format for issues for anomaly reports. The contractor Test Director is not responsible for resolving the anomalies, but must gather adequate data and assist the assigned team or individual evaluating the anomaly.

(f) Track anomaly status. The Test Director will recommend classifications for each anomaly a severity number and type when documenting it as a RAZOR issue. This will ensure that the team can sort anomalies by severity and type, which becomes important when there are dozens or hundreds of anomalies to track. The anomaly database also has a status that will allow the team to track anomalies as "fixed" or "needs retesting".

(g) Document all test deviations. A deviation from any formal test plan, or approved test component procedure, requires the approval of the Test Manager and the IV&V Group representative. Team members should request a list of waivers and deviations before the test, if possible. The deviation should be briefed to the Test Director and the V&V Group. Details of the deviation should be noted in the test log, and include the rationale for the deviation and its effect on test quality.

4.7 Analyze and Report the Results of Testing

This section describes the methodology for analyzing and reporting the results of all testing. The contractor test team and the V&V Group team needs to:

(a) Collect and analyze test output data. This includes test logs and any notes taken no matter how trivial they appear.

(b) Look for any discrepancies in the data that may indicate problems with the test.

(c) Analyze the data so that all test results trace back to the Requirements Traceability Matrix (RTM) or via DOORS links to ensure that the requirements are met.

(d) The V& V Group representative needs to provide a daily test status update to the PE. The status report should discuss the testing status, the anomalies discovered, test deviations and planned test activities for the next day. The contractor and the IV&V Group write test reports and a test summary report and present it to the ORDA Contractor TP&M Focal Point.

PART V-GENERAL TESTING POLICIES

This section will describe some general testing policies that apply to all formal tests. It will include the responsibilities of contractor, ROC, and IV&V test representatives who are responsible for the planning, management and execution of all test activities. It also addresses the procedures for the monitoring of QA and CM during testing, the rules for test suspension and resumption, repeating tests and the proper use of standards, practices and conventions. It will also address the responsibilities of the V&V Group representatives who witness all formal tests

5.1 Witnessing of Tests

The Government observers as part of the V&V Group will witness all formal tests executed in the system and acceptance test phases. The Government will appoint, coordinate, and schedule these observers. These test witnesses will report the results of all formal tests, through a single IV& V Group representative, to the PE. Their duties are the following:

(a)   Participate in TRR meeting before formal tests. This could be done by teleconference if necessary.

(b)   Attend the test "kickoff" meeting.

(c)   Accomplish "spot check" of test item and test bed to ensure proper configuration.

(d)   Monitor all test steps according to test procedures and record any anomalies, discrepancies, and deficiencies.

(e)   After completing test, attend post-test meeting to formally record all requirements that passed or failed.

5.2 Software CM during Testing

The test team will execute all formal tests using configuration-managed software. During the component and integration test phases, the contractor developers and the contractor support team will maintain CM of the software units and hardware components. The contractor software CM is described in the ORDA Software Development Plan (SDP). Beginning with the System Test phase, ROC CM will assume CM activities. Without strict CM of software, results are often non-repeatable. Therefore, the test team will adhere to strict CM of software to ensure repeatable results.

5.3 Test Suspension and Resumption

The contractor test plan for each test level will specify the conditions under which a test may be suspended. The contractor should not suspend a test when an anomaly occurs, unless the anomaly itself makes further testing inefficient or unreliable. All radar

equipment must be available during the test. In the event any of the critical equipment needed by a test component is unavailable due to hardware problems, power outages, or circumstances outside the control of the test team, the Test Manager may suspend all or portions of the test.

When a test is suspended, the Test Manger, with the concurrence of the IV&V Group representative, will determine what components must be re-initiated. The test team will inform the test team overseeing these test components of the condition forcing the suspension and provide the impact on their test component. Once the event that forced the suspension has passed, the Test Manager will verbally instruct the test team where to resume their test activities, write a deviation memorandum to document the verbal instructions and include the reason for the suspension.

5.4 Repeating Tests

The Test Director and the IV&V Group representative will collaborate on a repeat of all or part of the test as necessary. The test team will repeat the test if any of the following items change, were not checked, or if some form of interruption occurred.

(a) Adaptation parameters were not set properly

(b) Equipment setup and configuration were not verified prior to starting the test or the system experienced a power failure during a test requiring continuous use

(c) System failures terminated a test or procedure prior to normal completion.

5.5 Standards, Practices, and Conventions

All standards for test plan and procedures documentation, equipment and radar operations procedures, safety operations, test and evaluation procedures, and test personnel management conventions will be followed during formal tests.

5.6 Test Documentation

The test team will deliver at least one test plan, test description, and one test report during each phase of testing per the CDRL.

ANNEX A-BIBLIOGRAPHY

This annex lists all commercial and military guides and standards and all legacy and current WSR-88D programmatic documentation pertinent to the ORDA test and evaluation program.

Commercial Standards:

ANSI/IEEE Standard 610.12-1990 - Glossary of Software Engineering Terminology

ANSI/IEEE Standard 1012-1998 - Software Verification and Validation Plans

Standard for Information Technology, Software Life Cycle Processes Software Development, J-Std-016, 30 September 1995

Military Guides and Standards:

DoD Defense System Management Guide, March 1998 (Third Edition)

DoD Standard 5000.2-R, Mandatory Procedures for Major Defense Acquisition Programs (MDAPS) and Major Automated Information System (MAIS) Acquisition Programs; 10 June 2001

Military Standard 490A, Specification Practices, 4 June 1985

Applicable Legacy WSR-88D Program Documentation:

WSR-88D System/Subsystem Design Document (SSDD)

WSR-88D External System Interface Control Documents (ICDs)
    RDA Interprocessor
    Remote Maintenance System (RMS)
    Radar Product Generator (RPG)

WSR-88D RDA Software Requirements Specifications and Internal ICDs

WSR-88D Interface Requirement Specifications (IRS)

WSR-88D RDA Software Design Descriptions (SDDs)

OSFCOP-DIR-36, WSR-88D Test Bed Configuration Control - Mar 94

WSR-88D Software Management Plan (31 Jan 94)

WSR-88D Configuration Management Plan - 7 Jun 96

WSR-88D ROC Software Quality Assurance Plan

ROC Modification/Retrofit Management Plan - 7 Sep 93

Hardware Modification Test Standard - Draft 12 Aug 94

ROC Software Documentation Requirements - 14 Apr 98

Applicable ORDA Documentation:

NEXRAD Product Improvement (NPI) Project Plan

Specifications and Interface Control Documents, Plans, and Reports (where applicable):

(2830001 Pt 1)   Facility Development Specification for Tower/Utilities (B4, CI-01)

(2830002 Pt 1)   Critical Item Development Specification for Antenna Pedestal (B2, CI-02)

(2830003 Pt 1)   Critical Item Development Specification for Transmitter (B2, CI-03)

(2830004 Pt 10   Critical Item Development Specification for Receiver (B2, CI-04)

(2830014)   Critical Item Development Specification for Signal Processor (B2, CI-14)

(2830005 Pt 1)   Critical Item Development Specification for RDA Control (B2, CI-05)

(2830006 Pt 1)   Critical Item Development Specification for Wideband Communications Link (B2, CI-06)

(DV1208257F, SCN-002)   Prime Item Development Specification for RPG Equipment (B1, CI-07)

(2820001)   Computer Program Development Specification for RDA Status and Control Program (B5, CPCI-01)

(2820002)   Computer Program Development Specification for Signal Processing Program (B5, CPCI-02)

(2820006)   Computer Program Development Specification for RDA System Operational Test Program Software (B5, CPCI-06)

(1208266 D)   Computer Program Product Specification for Data Processing Diagnostics (C5, CPCI-07)

(1208277D)   Computer Program Product Specification for Operating System (C5, CPCI-10)

(2620035)   Interface Control Document for Processor/RDASC Processor

(2620025)   Interface Control Document for Receiver Signal Processor/Archive I

(2620010)   Interface Control Document for Archive Level II/User

(2620014)   Interface Control Document for Antenna Pedestal/RDA Control

(2620030)   Interface Control Document for Transmitter/Receiver Signal Processor

(2620031)   Interface Control Document for Antenna Pedestal/Receiver Signal Processor

(2620032)   Interface Control Document for Antenna Pedestal/Transmitter

(2620042)   Interface Control Document for Transmitter/RDA Control

(2620033)   Interface Control Document for Utilities/RDA Control

(1208320I)   Interface Control Document for Base Data/User

(2620002)   Interface Control Document for RDA/RPG

(2620004)   Interface Control Document for RDA/RMS

(2620019)   Interface Control Document for RDA/RDA Interprocessor

ANNEX B-ACRONYMS

This annex lists all pertinent acronyms, with their meanings, that are critical to the ORDA test and evaluation program.

CCB	Configuration Control Board
CCR	Configuration Change Request
CI	Configuration Item
CM	Configuration Management
COTS	Commercial Off-The-Shelf
CPC	Computer Program Component
CPCI	Computer Program Configuration Item
DOD	Department Of Defense
DSMC	Defense Systems Management College
ECP	Engineering Change Proposal
FAA	Federal Aviation Administration
HWCI	Hardware Configuration Item
ICD	Interface Control Document
IEEE	Institute of Electrical and Electronics Engineers
IV&V	Independent Verification and Validation
MSCF	Master System Control Function
NEXRAD	Next Generation Weather Radar
NSSL	National Severe Storms Laboratory
NTR	NEXRAD Technical Requirements
NWS	National Weather Service
ORDA	Open Radar Data Acquisition
OS&T	Office of Science and Technology
PDR	Preliminary Design Review
PMC	Program Management Committee (NEXRAD)
PE	Project Engineer
PL	Program Leader
PSE	Project System Engineer
PUP	Principal User Processor
QA	Quality Assurance

RDA   Radar Data Acquisition
RDASOT   RDA System Operability Test
ROC   Radar Operations Center
RMS   Remote Maintenance Subsystem
RPG   Radar Product Generator
RPS   Routine Product Set

SDF   Software Development File
SME   Subject Matter Expert

TEMP   Test and Evaluation Master Plan
TRB   Test Review Board
TRR   Test Readiness Review

WSR-88D   Weather Surveillance Radar-1988, Doppler

ANNEX C-DEFINITIONS

This annex lists all pertinent terms, with their definitions, that are critical to the ORDA test and evaluation program.

Acceptance Test - A formal test conducted to determine whether or not a system satisfies its acceptance criteria and to enable the customer or customer's surrogate to determine whether or not to accept a system or component.

Anomaly - Anything observed in the operation or documentation of system that deviates from expectations based on previously verified system products or reference documents. An anomaly does not become a defect until after the anomaly is reviewed by the TRB. Test steps should have clear and unambiguous Expected Test Results (ETRs).

Anomaly Classifications – The TRB classification of an anomaly. The TRB may assign the following classifications: 1) Pass with waiver/deviation 2) Pass, withdraw issue 3) Failed - retest required.

Anomaly Prioritization – The TRB prioritization of an anomaly. The TRB may assign the following priorities: 1) Critical 2) Major 3) Minor.

B1 Document - A software requirementMIL-STD-490A prime development item specification document. There is a B1 document for each HWCI if documentation follows the MIL-STD-490A specification.

B5 Document - MIL-STD-490A software requirement specification document. There is a B5 document for each CPCI if documentation follows the MIL-STD-490A specification.

Deviation – The system meets the requirement in spirit but not in letter and a deviation waiver has been requested. For example, if a restart time requirement is 90 seconds and the system requires 100 seconds, the intent of the requirement was met but not the letter. The test passed only with approval of the deviation to the performance requirement.

Inspection - formal evaluation technique in which software requirements, design, or code are examined in detail by a person or group to detect faults, violations of development standards, and other problems.

Integration Test - A test in which software components, hardware components, or both are combined and tested to evaluate the interaction between them.

Interface Control Document (ICD) - defines the interfaces for software and hardware. This document also defines electrical interfaces, such as data lines, control lines, and timing sequences; I/O conventions; I/O operational sequences; and buffers.

Interface Test - A test conducted to evaluate whether systems or components pass data and control correctly to one another.

Metric - A quantitative measure of the degree to which a system, component, or process possesses a given attribute.

Module - A program unit that is discrete and identifiable with respect to compiling, combining with other units, and loading; a logically separable part of a program. The terms module, component, and unit, are often used interchangeably.

Regression Test - retest of selective components of a system to verify that modifications have not caused unintended effects and that the system still complies with requirements.

SDD Document - MIL-STD-498 software design document. There is an SDD document for each CPCI if documentation follows the MIL-STD-490A specification.

SRS Document - MIL-STD-498 software requirement specification document. There is an SRS document for each CPCI if documentation follows the MIL-STD-490A specification.

System Test - A formal evaluation of the ability of the fully integrated radar system to meet specific documented requirements. The evaluation is based on specific pass/fail criteria. The System Test has a test plan, procedures, and a report. It is conducted at the ROC by meteorologists and software engineers using the ROC WSR-88D Test Bed.

Test Case - A single run of a test task using unique input data or execution conditions.

Test Component - A test component is an independent self-contained reusable test that contains both requirements and detailed step-by-step procedures. This document states all equipment, staffing, and reports required to complete the component.

Test Driver - A software module used to invoke a module under test, and, often, provide test inputs, control and monitor execution, and report test results.

Test Item - A software item that is an object of testing.

Test Log - A chronological record of relevant details about the execution of tests.

Test Objective - A identified set of software features to be measured under specified conditions by comparing actual behavior with the required behavior described in the software documentation.

Test Plan - a document describing the scope, approach, resources, and schedule of intended test activities. It identifies test items, the features to be tested, the test testing tasks, who will do each task, and any risks requiring contingency planning.

Test Procedure - A document specifying a sequence of actions for the execution of a test.

Test Readiness Review - A review conducted to evaluate preliminary test results for one or more test items; to verify that the test procedures for each test item are complete, comply with test plans, and satisfy test requirements; and to verify that a project is prepared to start formal testing, or proceed to the next level of testing.

Test Summary Report - A document summarizing test activities and results. It also contains an evaluation of the corresponding test tasks.

Unit Test - A test of individual hardware or software units or groups of related units.

Waiver – The system does not substantially meet the requirement in spirit or in letter and a requirement waiver has been requested.